this lack of care on the part of some (but fortunately not all) surgeons, unless it is that the results in some cases, in spite of careless feeding, are so brilliant that the impression is gained that no particular care is necessary. But when one stops to consider the conditions present it seems little short of criminal to treat those cases as other than cases of ulcer still, until they have had a long enough time for thorough healing.

After operation the ulcer is still present and potent for evil, or it is possible to produce a jejunal ulcer on the jejunal wall opposite the new stoma by constant trauma of rough food plus a hyperacid gastric juice. All cases of gastro-enterostomy should be given, postoperative, a regular ulcer diet, giving the old ulcer the most favorable opportunity to heal and preventing food irritation elsewhere, notably at the site of the new opening, surrounded as it is by tender and vascular mucous membrane, or opposite the stoma, as already explained. The postoperative ulcer cure may be hurried rather more than under strictly medical conditions, but the fact remains that every opportunity for healing and cicatrization should be given, involving, as this does, weeks or months during all of which time the diet should be bland, soft, and free from all thermal, mechanical, or chemical irritants.

When this is systematically done we may hope in properly selected cases to get the percentage of surgical cures more nearly approaching the 100 per cent. mark, and too much stress cannot be laid on the importance of the food and drink factors in the attempt to attain perfect results.

STUDIES IN FRACTIONAL ESTIMATIONS OF STOMACH CONTENTS.[1]

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In reviewing historically the advances in our knowledge of the chemism of the stomach in health and disease, one is forcibly impressed by the fact that since the introduction into clinical medicine of the stomach-tube by Kussmaul and its rapid adoption by the profession at large, little of great moment has been added to our fund of information regarding the pathological chemism of this organ under conditions of disease. Subsequently, and within a short period, hyperchlorhydria was differentiated from subacidities, achylia gastrica was recognized as an entity, the association of hyperacidity and hypersecretion established in their frequent relation to organic disease, and many other studies made.

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[1] These studies were carried on under the tenure of a George Blumenthal, Jr., Fellowship in Pathology.

The animal experimentation of the schools of Pawlow, Boldyreff, Heidenhein and others and the experimental roentgenographic work which followed have since then afforded a more accurate and scientific basis upon which to build our knowledge of the physiology of the stomach. Thus were the foundation stones for our understanding of the physiology of gastric secretion, gastric motility, the pyloric and cardiac reflexes laid down in vivisection. But the application of these facts to man remained theoretical rather than practical, due to natural limitations in the adoption of human clinical material to the conditions of animal research.

From time to time isolated studies on persons with fistulæ of the stomach or duodenum have added a few facts to those previously recorded. The classic observations of Beaumont are one of the best examples of studies carried out under the handicaps and conditions incident to human investigations. More recently, Hayem,[2] Bourget[3] and others attempted, by the method of introducing the stomach-tube at successive times in the course of digestion, to study the cycle of events taking place. This latter method was tedious, incomplete, and artificial.

As early as 1895 Schuele[4] published an article on the secretion and motility of the normal human stomach, as observed by means of a catheter which he left *in situ* throughout the cycle of digestion, thus simulating a gastric fistula. He was able to demonstrate the curve of acid secretion and actually ascertained many facts pertaining to secretion and motility, on diets of carbohydrate, fats, meat, etc. After a lapse of several years there occurred a renewal of interest in this method of studying the human digesting stomach, as was marked by the appearance of publications by Ehrmann,[5] Ehrenreich,[6] and Skaller.[7] Ehrenreich, in particular, made careful and accurate observations by means of a gastric catheter, withdrawing specimens by aspiration at frequent intervals. He was able to plot curves of acid and ferment secretion, to note the regurgitation of duodenal contents in normal and pathological cases, and to determine the effects on secretion and motility of the introduction of eggs, milk, etc.

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[2] Maladies de la Tube Digestif, 1905.

[3] Die Krankheiten des Magens, 1906, first edition, p. 17.

[4] Ztschr. f. klin. Med., 1895, xxviii, 461.

[5] Berl. klin. Wchnschr., 1911, xlviii, 2226.

[6] Ztschr. f. klin. Med., 1912, lxxv, 231.

[7] Berl. klin. Wchnschr., 1913, l, 2176; 1915, lii, 105.

Considering, however, that this method was the nearest approach to the conditions of animal research the subject did not receive the attention to which it was entitled. Further communications were absent until the recent revival of interest in the subject, as marked by the appearance of a series of articles by Rehfuss and his collaborators,[8] beginning in 1914. In these studies Rehfuss investigated by means of a catheter, to the distal end of which was attached a slotted metal capsule, the physiology of fasting and digesting stomach of normal persons; in small part he extended these studies to cover some diseased conditions. By frequent aspirations he was able to plot curves of acid and ferment secretion, ascertain the emptying time of the organ, secretion of mucus, etc. The observations of Rehfuss are of the greatest practical importance and bid fair to offer a method of studying gastric digestion far more complete and accurate than the single test-meal methods hitherto at our disposal.

A cursory review of the new facts thus brought to light is essential to the further understanding of the subject. Rehfuss determined that our idea of the fasting content of the normal human stomach was erroneous. While previously it had been held by Strauss,[9] Tuchendler,[10] Boas,[11] Bjorbjarg[12] and others that all amounts over 20 c.c. of fasting fluid were pathological, Rehfuss[13] demonstrated on apparently healthy medical students amounts varying from 30 to 120 c.c. Approximately 50 per cent. of these contained bile and trypsin regurgitated from the duodenum; most of them contained some free (20 to 40 per cent.), and some total acid (26 to 50 per cent.). This fact in itself was sufficient, in his opinion, to overthrow the contention of the above-mentioned authors that fasting contents of over 20 c.c., so-called "macroretention," was indicative of irritative hypersecretion in association with ulcer, cholelithiasis, and other organic conditions.

Rehfuss further established three types of secretory curves as normal, namely, the isosecretory, the hypersecretory or continued secretory, and the hyposecretory curve, depending on the rapidity of acid secretion, height of acidity attained, and maintenance of the acid crest to the end of the digestive period. He was unable to demonstrate a universal type of curve for all persons. A few cases of gastric ulcer, gastritides, and other conditions were observed, but too few from which to draw conclusions. Achylia gastrica was studied thoroughly, and those cases of spurious achylia (those in which there is a rise of acid toward the latter half of digestion) differentiated from those in which the achylia is true and constant throughout.

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[8] Am. Jour. Med. Sc., 1914, cxlvii, 848. Rehfuss, Bergheim and Hawk: Jour. Am. Med. Assn., 1911, lxiii, 11, 909. Bergheim, Rehfuss, and Hawk: Jour. Biol. Chem., 1914, xix, 345. Rehfuss and Hawk: Jour. Am. Med. Assn., 1914, lxiii, 2088. Clark and Rehfuss: Jour. Am. Med. Assn., 1915, lxiv, 1737. Rehfuss: Jour. Am. Med. Assn., 1915, lxiv, 569. Fowler, Rehfuss, and Hawk: Jour. Am. Med. Assn., 1915, lxv, 1021.

[9] Deutsch. Arch. klin. Med., 1895, lvi, 87.

[10] Deutsch. med. Wchnschr., 1899, xxv, 390.

[11] Diag. u. Therap. der Magenkrankheiten, 1911, sixth edition.

[12] Arch. f. Verdauungskr., 1908, xiv, 251.

[13] Loc. cit.

In the following studies we have attempted to apply the method of fractional estimation of gastric contents to persons suffering from abdominal symptoms and to ascertain to what extent and in what degree pathological processes and abnormal stimuli alter the cycle of digestion, the emptying time of the stomach, the factor of duodenal regurgitation, etc.

The studies are based upon over 200 curves taken from patients in the medical wards and dispensary of the Mt. Sinai Hospital, representing all phases and varieties of abdominal disease. In a large percentage of the cases the clinical diagnosis was confirmed by operation. Throughout, the attempt has been made conscientiously to consider only such cases in which the symptoms have been clear-cut and definitely indicative of pathological conditions.

EXAMINATION OF THE FASTING CONTENTS. Our technic has been to require the patient to swallow the Rehfuss tube[14] at 8 A.M., all other food or drink having been proscribed since the evening meal of the previous day. When the question of pyloric obstruction arose, the patient ate on the previous night at 10 o'clock thirty raisins with the skins and seeds. The swallowing of the tube is actually an easy matter; we having never encountered a single patient who has declined or been unable to accomplish it. Retching is avoided to the greatest possible degree to prevent the tendency to regurgitate duodenal contents into the fasting organ. The stomach was aspirated in several positions until no futher material was obtainable.

The fasting contents were usually clear, watery, or slightly turbid in appearance. In about one-quarter of the cases bile was present in amounts varying from a slight tinge to a heavy golden-yellow color. Except in cases in which gastro-enterostomy had been performed (in these bile was constantly present and in large amounts) there appears to be no definite clinical significance to the appearance of bile in the fasting contents. When present it denotes a patent pylorus. It may be persistently absent in organic pyloric stenosis but is usually present in functional pylorospasm. There is no question that in the process of swallowing the tube some retching, if only slight, invariably occurs, and as the acts of vomiting and retching are associated with a relaxation of the pylorus it is easily comprehensible that this will explain, in a large number of instances, the presence of bile in the fasting contents.

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[14] The Einhorn duodenal tube (Medical Record, 1910, lxxvii, 98), is equally serviceable and answers all purposes; it was frequently used. A gastric tube devised by M. Gross (New York Med. Jour., 1893, lviii, 600), was probably the first tube of its kind to be suggested for such a purpose.

The amount withdrawn from the fasting stomach varies from nothing to 140 c.c. It rarely happens that nothing is withdrawn. This series includes practically no absolutely normal cases, but the experience of Rehfuss and his collaborators is highly interesting in that he was able to demonstrate in normal individuals amounts varying from 20 to 120 c.c. In our series the amounts recovered were as follows: gastric neuroses, 2 to 60 c.c., averaging 31 c.c.; gastric or duodenal ulcer, 20 to 140 c.c., averaging 54 c.c.; cases of chronic appendicitis, 30 c.c.; marked subacidity or achylia cases were either empty or showed at a maximum 10 to 25 c.c.; functional hypersecretion 50 to 70 c.c.

We were unable at any time to duplicate the large amounts found by Rehfuss and his co-workers in normal males, or of Fowler and Zentmire[15] in normal or approximately normal females. In our series the larger amounts seen with ulcer are suggestive of the hypersecretion which so frequently accompanies this condition and supports the contentions of Rubow,[16] Bamberger[17] and others on this point. Bamberger, for instance, designates as "macroretention" amounts over 21 c.c. and found this in 55 per cent. of real ulcer cases, and in 58 per cent. of hypersecretion cases, in which latter group the possibility of ulcer was a likely one. It should be noted, however, that his stomach contents were removed with the older and more usual type of stomach-tube.

The acidity of the fasting residue varies considerably, but follows in general the acid titration of the digesting meal. The acid titer is never above that of the test breakfast; usually it is lower than its maximum; in cases of hyperacidity it is materially lower. But in those cases which approximate the normal curve, the total acid of the fasting content is usually near the same figure as at the end of the fractional test meal. This should be designated as the "minimal acidity" of the stomach. In cases with normal or slightly hyperacid curve, the fasting titration shows free acid of 32 to 52 per cent.; total acid of 44 to 68 per cent. In subacidity cases free acid is absent, total acidity diminished to 20 per cent.

Mucus in small amounts was present in all cases, the origin in part being salivary mucus, in part the secretion of the pyloric antrum. It is the deglutitory effort which increases the amount of the fasting contents found by this method, and makes the presence of salivary mucus, in small amounts fairly constant. On the other hand, cases of chronic gastritis, marked subacidity, and carcinoma exhibit usually a marked increase in mucus which sediments out in a heavy layer on standing.

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[15] Jour. Am. Med. Assn., 1917, lxviii, 167.

[16] Arch. f. Verdauungskr., 1906, xii, 1.

[17] Ibid., 1911, xvii, 241.

Food particles recovered by this method have the same significance as when found by any other method, namely, are highly suggestive of pyloric obstruction. Raisins given the previous night appear as shreds of raisin skins in the aspirated contents. When food residue occurs a higher acidity titration is the rule, as the organ, never being free of the food stimulus, continues to secrete acid of digestive concentration; that is, its "minimal acidity" is raised. Blood has been noted only in cases of carcinoma. Sarcinæ and yeasts are occasionally found and have the usual significance.

THE TEST BREAKFAST. A heavy oatmeal gruel was utilized as the test meal. The gruel was made by adding two heaping tablespoonfuls of oatmeal to a quart of water and boiling it down, over a small flame, until it was reduced to a pint in volume. The gruel was then filtered through gauze to remove the solid particles; a pinch of salt was added to make it more appetizing, except when chloride studies were being made. After he had successfully swallowed the tube and the fasting contents had been aspirated, the warm gruel was given to the patient to drink. If a large fluid residue remained in the fasting stomach from the previous day, gastric lavage was first practised, because the test was always performed on an empty stomach. Every fifteen minutes thereafter 10 to 15 c.c. of the contents of the stomach were aspirated for examination; the aspirations were continued until the stomach became empty.

THE ACIDITY CURVE. Every specimen was titrated for free and total acid and the resulting amount expressed in cubic centimeters of decinormal sodium hydrate per 100 c.c. of stomach contents. A curve, based on the results, was then plotted. The appearance of bile in the aspirated fractions was carefully noted. The emptying time of the organ was estimated by the disappearance of the starch reaction as determined by the addition of tincture of iodin in excess to each tube. The presence of mucus was carefully noted; rennin and pepsin were tested for in cases of anacidity, and the Wolff-Junghans test performed in cases suspected of carcinoma.

As the clinical material at our disposal included practically no normal cases we do not feel able to demonstrate curves of entirely normal persons. However, in the course of collecting so large a series one sees many curves which are practically normal, as judged by the standards set by Rehfuss and his co-workers in their investigations of the stomach of students free from disease. Many cases were noted which corresponded to the three types of normal secretory activity, namely, the isosecretory, hyposecretory, and the hypersecretory or continued secretory classes. The publications of these investigators clearly demonstrated these curves on normal individuals. In a group of cases numbering over 50 instances, in which are included all cases free from organic disease, we noted many illustrations of these normal curves. The pure gastric neuroses and the so-called normal cases (hernia, etc.), fall easily into this group. Free acid appeared soon after the beginning of the test; maximum total acidity (60 to 70 per cent.), was reached at about one hour; thereafter there was a slow decline approaching the base line, though never quite reaching it. The stomach emptied itself usually in two or two and a half hours. The course varied but slightly in the hypersecretory cases, the total acidity reaching slightly higher levels to 80 per cent. and over. These latter cases empty themselves in the same time, though the fall of the acidity was slower and did not approach the base line until later, if at all. The hyposecretory type was essentially the same as the isosecretory, the acid not rising above 50 per cent., emptying time being usually two hours (Figs. 1, 2, and 3).

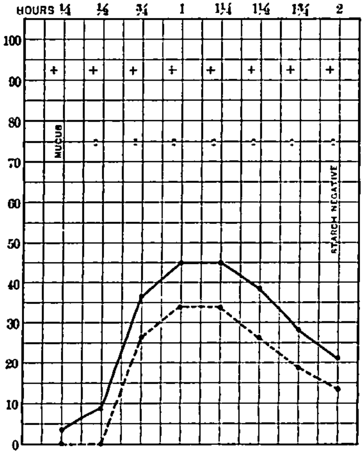

FIG. 1.—Isosecretory type.

A regurgitation of bile normally took place as the height of digestion was passed, that is, about one and a quarter or one and a half hours after the meal. This regurgitation frequently increased as the digestion approached conclusion and should be regarded as a phenomenon consistent with a healthy functionating stomach. No relationship could be traced between the degree of biliary regurgitation and the fall of acidity toward the end of digestion, bile being often abundantly present with a sustained acidity, while conversely the fall of acid may have been sharp and yet no reflux of duodenal contents have taken place. Nor has the presence of mucus been in any way consistently proportionate to the fluctuations of acidity or to the fall of acidity at the end of digestion.

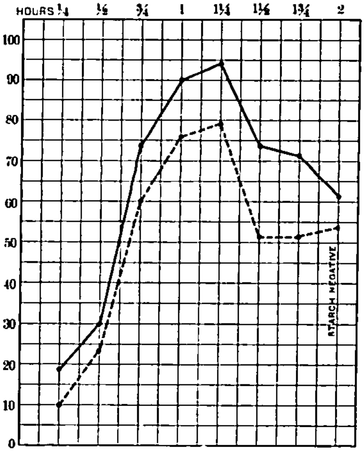

FIG. 2.—Hypersecretory type.

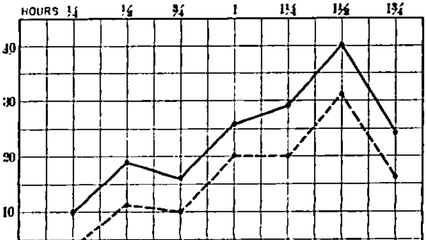

FIG. 3.—Hyposecretory type.

While it was true, as a rule, that the height of secretory activity occurred at one hour after the ingestion of the gruel, exceptions were not at all infrequent; one of the advantages of this method consisted in discovering such instances of late secretory activity, and in a few cases of premature activity. Thus Fig. 4 illustrates a case with total acidity of 24 per cent. at the end of one hour, while half an hour later the acidity had reached 92 per cent.

An illustration of earlier secretory activity is afforded in Fig. 5, in which the height of acidity (54 per cent.) was reached at three-quarter hours, while at one hour it was only 36 per cent. However, these cases were not by any means frequent, and in those cases free from organic or secretory derangements the height of digestion took place at one hour.

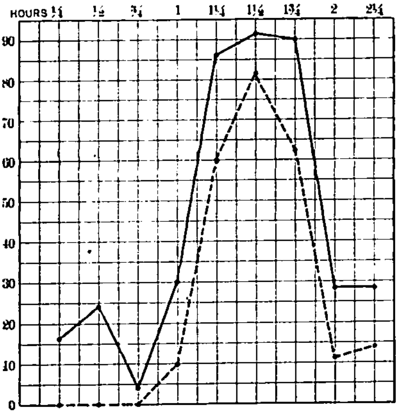

Fig. 4.—Late hyperacidity.

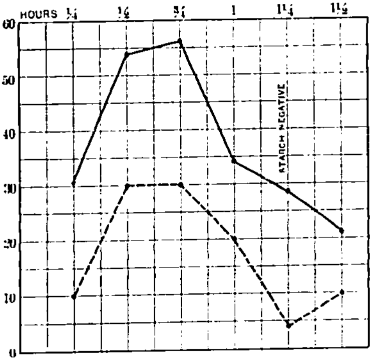

Fig. 5.—Early rise in acidity.

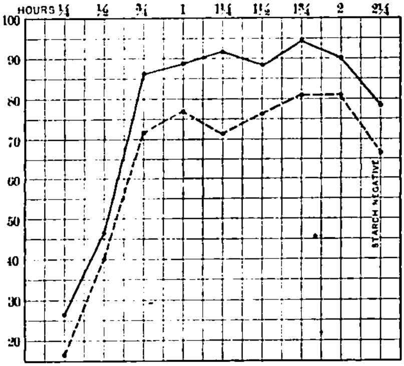

FIG. 6.—Simple hyperacidity.

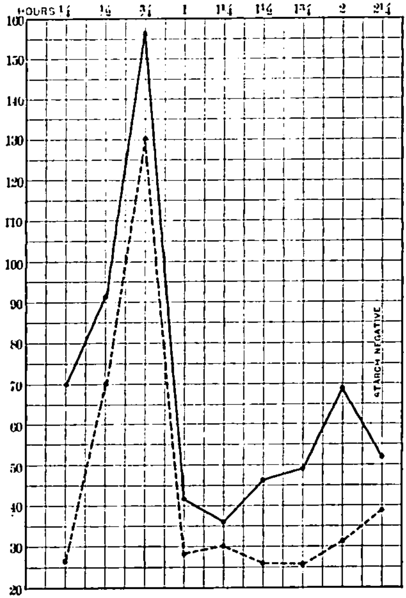

FIG. 7.—Neurosis.

Functional Secretory Disturbances; Hyperchlorhydria. These cases are those in which the total acidity rose rapidly and higher than in the normal cases, though the emptying took place in the usual time. In general the figures obtained by this method, using the oatmeal gruel as a test substance, were lower by comparison than those after the Ewald test breakfast of a roll and tea extracted after one hour. The hyperacidity ranged between 80 and 110 per cent. and often reached 130 and 140 per cent., or exceptionally higher. Fig. 6 illustrates a case of simple hyperacidity. Fig. 7 is an illustration of larval hyperacidity in which the total acidity at three-quarters of an hour was 148 per cent., while fifteen minutes later it was 42 per cent. In Fig. 8 one sees an example of late hyperacidity in which at one and three-quarter hours the total acidity was 40 per cent., while a quarter hour later it was 142 per cent.

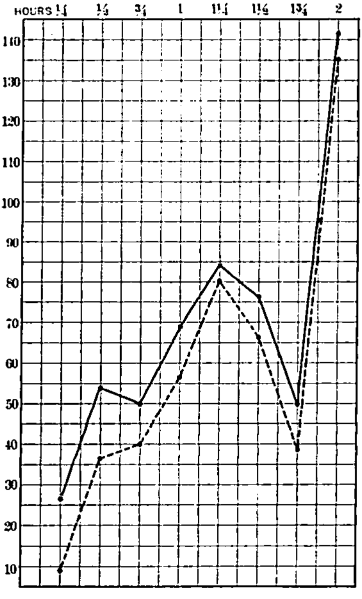

Fig. 8.—Neurosis hyperacidity.

Cases of Hypersecretion. This type of case is a most interesting one to study, for the secretion of gastric juice may continue for hours after the normal period of digestion. A reference to Fig. 9 will show a case of hypersecretion in which, for several hours after the stomach was free of all starch, a clear watery secretion of pure gastric juice continued to be secreted. Or, Fig. 10, a case of migraine with hypersecretion in which a watery juice continued for six hours after the ingestion of the meal. A delay in motility was apparent throughout, as even at the end of the six hours starch was present. To determine the nature of the hypersecretion, the stomach was completely emptied at the end of the six hours, 165 c.c. being obtained. The secretion of gastric juice immediately ceased (alimentary hypersecretion). That this case was one of pure functional disturbance was proved by the fact that at exploratory laparotomy no organic disease was present and the pylorus admitted two fingers. In another case, probably associated with ulcer, the secretion continued in spite of emptying the stomach of all residue (continuous hypersecretion). The hypersecretion continued without cessation, the experiment being interrupted only by the fatigue of the patient.

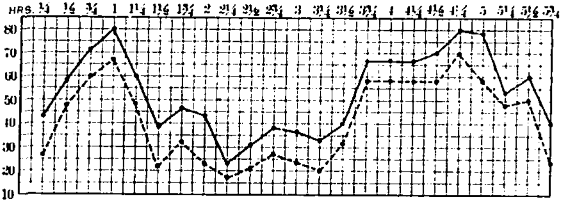

Fig. 9.—Continued hypersecretion.

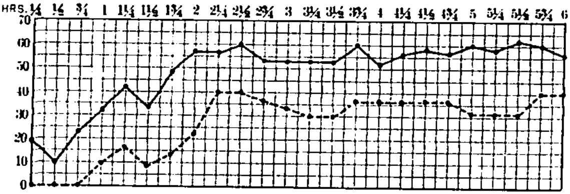

Fig. 10.—Alimentary hypersecretion.

Anacidity and Achylia Gastrica. In cases of anacidity there was a lack of free HCl throughout, though the total acid may have risen to 20 to 30 per cent. at some time of the digestion. Ferment strengths were maintained, fasting contents were usually absent or of minimal quantity, and the stomach emptied itself within two hours. In the achylia cases free acid was consistently absent throughout; total acid fluctuated between the extremely narrow limits of 8 to 10 or at most 14 per cent. The emptying time was shortened to one and a half or one and three-quarter hours; ferments were absent (Fig. 11). A rise of acidity was uncommon at any time of digestion, although it occasionally occurred. A distinct classification of psychical and chemical achylias we have been thus far unable to confirm. Since achylia gastrica should be regarded merely as an advanced stage of anacidity, those cases with late rise of acidity belong properly to the class of anacidity, rather than create a new classification of "spurious achylia" (Rehfuss). Some of the most advanced examples of achylia occurred in cases of pernicious anemia; ferments as well as mineral acid were lacking in these instances.

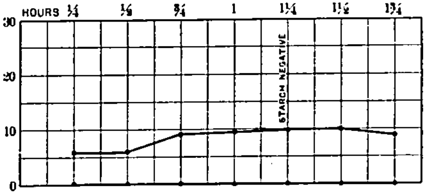

FIG. 11.—Achylia gastrica.

ORGANIC DISEASES; GASTRIC OR DUODENAL ULCER. While it cannot be said there is a curve absolutely characteristic for ulcer, yet it may conservatively be stated that ulcer cases are associated with a curve of acidity that rises rapidly and is sustained if not throughout the cycle of digestion at least to within a short time (fifteen minutes) of its end. It is not the height of the curve of acidity that makes one suspect ulcer, for that could as well be the case in functional hyperacidity; it is the steady, rapid, prolonged rise and sustained plateau seen so consistently in ulcer cases (Fig. 12). The fall of acidity, if it takes place at all, occurs just before the final emptying of the stomach. A delayed motility was frequently a factor and indicated pyloric involvement, either functional or organic. The regurgitation of bile was most commonly absent or, when present, took place only at the very last phase of the digestion. The presence of mucus was not associated with ulcer, though occasionally it was seen in large amounts in the fasting contents and at the termination of the period of observation. In spite of what might have been expected, blood was absent throughout; a trace of blood was seen only once in a case of gastric ulcer and then in only one of the specimens withdrawn. Very little trauma was associated with this method of test meal and the presence of blood had therefore all the more significance.

The highest acidity seen was 116 per cent., occurring once one and a half hours and in another instance two and a half hours after the onset of digestion. In all of these curves the highest acidity

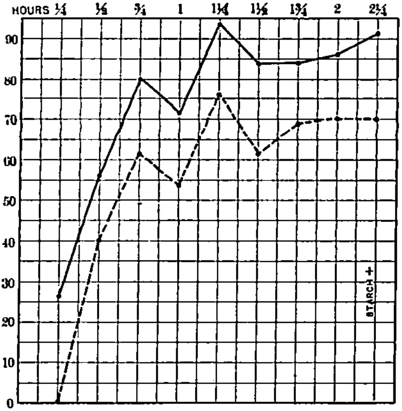

FIG. 12.—Ulcer of duodenum.

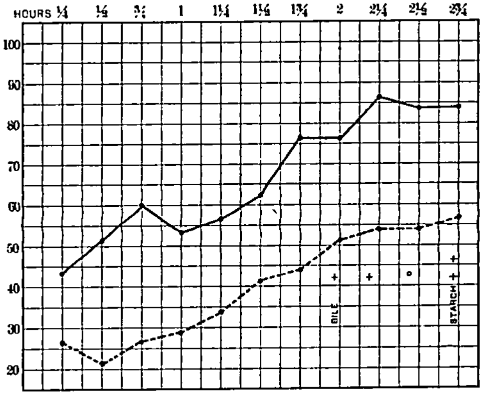

FIG. 13.—Pyloric stenosis.

took place not one hour after eating but one and three-quarter to two and a half or three hours after giving the test breakfast. This was a constant phenomenon. No case of subacidity had been noted in this series of ulcer curves. A mild hypersecretion was occasionally noted; after the starch had entirely left the stomach a strong acid secretion may continue for a half to two hours longer. This postdigestive secretion was clear, watery, contained little or no mucus and no bile. Chemical analysis of this fluid shows it to correspond closely to the analyses of pure gastric juice as found in the standard text-books. The hypersecretion was evidenced on the charts by the approach of the curves of free and total acid secretion. This was easily comprehensible when one considers that with the emptying of the stomach the protein in the test meal leaves the organ, diminishing the amount of the combined acid. The pure acid juice thereafter secreted contains only very small amounts of proteins or acid phosphates, as indicated by the narrow difference between the free and total acidities at this point.

Cases with pyloric stenosis show moderately high acidity at the outset (30 to 50 per cent.), and in addition exhibit a gradually ascending curve which was highest at its end and showed no tendency to drop. Motility was, of course, delayed (Fig. 13).

CHOLELITHIASIS; CHRONIC APPENDICITIS. To date we have found no possible means to differentiate these curves from those of ulcer. Hypersecretion was not observed, motility not delayed.

POST-GASTRO-ENTEROSTOMY CASES. These cases show normal or subacid curves; occasionally, in cases with recurrent symptoms of long duration, anacidity. The curves were characterized by a drop in acidity which took place at the end of the first hour; this drop was associated with a regurgitation of intestinal contents and was followed by a secondary rise in acid. The regurgitation of intestinal contents once begun, continued to the end of digestion. Cases after operation, with recurrent symptoms due either to functional disturbance of the motor and secretory mechanism or to organic stenosis at the stoma, exhibited a more prolonged secondary rise with a delayed motility lasting up to two hours or more, usually three hours. In cases with unduly large stoma a free regurgitation of intestinal contents into the stoma may occur not only throughout digestion but in the fasting state as well. The test meal leaves the organ early, yet the stomach is never empty. The delay in the emptying of the stomach, so often seen after the operation of gastro-enterostomy, was frequently a manifestation of the disturbed motor mechanism of the organ, as described more fully in a recent paper by Wilensky and Crohn.[18]

CARCINOMA VENTRICULI. These curves are those of marked subacidity, occasionally of anacidity. The almost flat curve of achylia was rarely seen (Fig. 14). The gastric ferments, rennin and pepsin, were retained in all the cases. Blood, which was practically never seen in other conditions, was very common, occurring toward the end of digestion, usually in several of the specimens as well as in the fasting contents. When blood was present the individual curves of free and total acid became divergent, due to the large amount of combined acid formed from the blood protein. Mucus was frequently abundant. We were unable to draw diagnostic conclusions from estimations of soluble albumin performed by the Wolff-Junghans method.

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[18] AM. JOUR. MED. SC., 1917, cliii, 808.

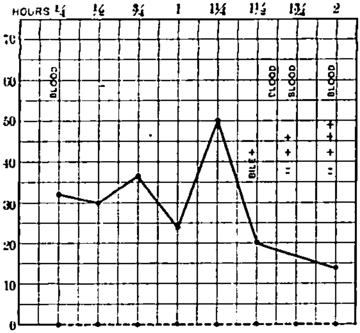

Fig. 14.—Carcinoma.

Miscellaneous. Chronic parenchymatous nephritis, the convalescent stage of acute intercurrent infections, syphilis of the stomach, give the curve of subacidity without novel characteristics.

The Diagnostic Significance of the Curves. Utilization of the Method. One who expects to find in the curves of the fractional estimation of stomach contents new and infallible diagnostic criteria will be disappointed. One who hopes to label each type of curve as representative of a particular disease will raise false hopes. On the other hand, *many of the curves are highly suggestive of certain diseases. There is a type of curve quite constant for ulcer; cases of hypersecretion; anacidity, achylia, and postgastroenterostomy cases show clear-cut types, individually representative of these conditions and easily recognized.* For the demonstration of digestive hypersecretion the method is unequalled. But the importance and greatest value of the method lies in the fact that it offers knowledge regarding the physiology of the entire cycle of digestion from the beginning fasting state through to the very end of the digestive period. We are in a position to gain information regarding the following points:

1. Fasting contents: amount, presence of food residue, presence of regurgitated bile, mucus, or blood.
2. Type of secretory activity as regards free and total acid, namely, the acid curve.
3. Duration of secretory activity, whether ceasing with the exit of the food or maintained as a hypersecretion thereafter.
4. Time of emptying of the stomach, that is, its motility.
5. Presence of mucus and time of occurrence.
6. Presence of bile, as indicative of pyloric relaxation and duodenal regurgitation.

If we are accustomed to draw diagnostic conclusions from the usual test meal at the end of one hour, we can surely form a better opinion with the added information which this test affords.

While the method may not give a finished diagnosis it gives numerous facts which when properly interpreted and pieced together we recognize as indicative of functional disturbance of the stomach associated with a particular disease. It combines in itself the best features of several of the well-known test meals, namely, the Ewald, the Riegel (motility test dinner), and the Boas oatmeal test for presence of lactic acid. It makes superfluous the complicated mathematical formulæ of the Mathieu-Rémond method for estimating motility.

A disadvantage of the method is the time required for its completion. In institutional work this is less of a factor, as the nurse can easily aspirate every fifteen minutes until the stomach is empty.

Recently, Best,[19] in a thorough review of the subject, strongly emphasizes the advantages which this method has over the single test meal, recommending it for further serious consideration at the hands of the profession. Fishbaugh[20] warmly recommends the method and calls attention to the insufficient, often misleading information furnished by the one hour test, as controlled by the fractional method. Andresen and d'Albora,[21] in an accurate estimation of many curves, found some very typical curves, as of duodenal ulcer and achylia.

For the scientific study of the chemism of the stomach in its departure from health to disease this test must take its place as one of the most valuable adjuncts to our present methods. Its field of usefulness for the study of the effects of medication, dietary therapy, psychical influences, operative procedures, etc., is unlimited.

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[19] Jour. Am. Med. Assn., 1916, lxvii, 1083.

[20] Ibid., p. 1275.

[21] Long Island Med. Jour., 1916, x, 133.